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Opponent review of dissertation thesis

„Spatial models of landscape responses to climate change“

written by **Mgr. Elvis Tangwa, MSc.**

at the study programme **Geography**, the field of study **Geoinformatics and Cartography**

at Faculty of Science, **Palacký University Olomouc**

Based on the commission of assoc. prof. RNDr. Martin Kubala, Ph.D., Dean of the Faculty, dated June 27, 2022, I submit a review of the above-mentioned dissertation.

Structure of the dissertation

The presented dissertation is conceived as a set of results of four papers published in impacted journals, to which the author has attached an accompanying commentary; btw. direct inclusion of the papers into the dissertation would shorten the work and effectively present the author's results. The scope of the work is 91 pages, of which the text itself is about 79 pages apart. The basic structure of the thesis was chosen according to the focus of the research. The set of topics deal with various themes that combine the approach of actual geotechnologies and the combination with other environmental data to derive key parameters for spatial modelling. In essence, the studies are basically an application of spatial modelling to improve understanding of landscapes, mainly due to climate change across different regions and scales.

Current issues

The subject of landscape responses to climate change research is almost exclusively defined in given spatial framework and spatial context, which clearly predetermines the use of geoinformation technologies to describe spatial models. There is the focus on different levels and models to understand response of landscapes in central Europe and East Africa in the presented thesis. The work contributes to addressing topical issues of climate change in three objectives, covering basic approaches from modelling landscape potential for selected crops and modelling changes in species richness to modelling the loss of habitat naturalness and changes in ecosystem functions.

Data and methods

The current state of the problem is adequately described regarding individual methods of the work and location of datasets; methods of scientific processing are divided according to basic research objectives in papers. Obviously, the issue handled in individual case studies is seriously extensive in terms of ecological and social overlaps, and a whole range of context exceeds beyond these considerations. The methods chosen for the solution of the work are based on existing models (e.g. EcoCrop, EUROMOVE, GLOBIO), but an individual approach can be seen for each sub-objective. The used datasets are very diverse, which, on the one hand, offers the possibility of different methodological approaches to data processing, on the other hand it may complicate comparability of results and overall conclusions for the main goal of the work. The statistical approaches are adequately selected, both for the evaluation and comparing of individual datasets. The study areas are related to data sources or participated projects, but it is questionable to what extent the results of individual case studies were influenced by the choice of experimental sites and what design of the experiment should be take this into account.

Objectives and results

In the presented thesis, the author has demonstrated a broad overview of the studied subject from a scientific point of view and he is scientifically focused on the field of methods for landscape potential and species distribution models, quantifying a topographic heterogeneity, modelling a variability in species richness and/or diversity loss and a vulnerability of natural habitats. Particular results can be seen in case of (individual) studies/papers; complex conclusions are not so clear, because of relation to datasets and model combinations. However, this is not a mistake, because the purpose of thesis was to present and model the different conditions using spatial modelling approaches to improve understanding of landscape development, mainly due to climate change, but also due to topography and landuse/cover change across multiple scales.

Comments and questions

Since the submitted thesis is based on set of papers, I do not intend to discuss the papers themselves that have undergone rigorous review procedures and they are related to the specific output of the research, but I will focus in particular on the accompanying commentary, which should complexly link outcomes or practical application. Here I appreciate critical discussion and conclusions on the topics. Conclusions are commented and the challenges for further research are presented too.

I have the following questions to the thesis for which I expect a response from the author during the defense:

1. There is the digital elevation model (DEM) as one of datasets used in the case study #2. Related to your results and discussion (mainly in chapter 7.2), what spatial resolution of DEM is suitable to model terrain attributes and reflects topographic heterogeneity for mapping variability in species richness? Depending on your previous answer, what source of data or technologies are suitable for this spatial resolution?
2. Another dataset worked with Corine Land Cover (CLC), mainly in the case study #3, and this dataset is too general (its minimum mapping unit) for applications in local level. I understood the usage of this dataset, but what other landuse/landcover (LULC) data could be actually used? What kind of geoinformation technologies could be applied for creating such LULC dataset?
3. Depending on your research, could you compare general advantages and disadvantages of (conventional) geostatistical methods, non-linear and hybrid methods for species distribution/ richness modelling? What limitations (prerequisites) have to be fulfilled for application of geostatistical methods?

Final evaluation

The submitted thesis meets the criteria for a dissertation and the results of this thesis were duly published. The author has demonstrated the ability of high-quality scientific work and the results of his work provide a wide range of practical experience that can be applied in various fields and, taking into account the current trends in geoinformatics, opens up other possibilities of their usage compared to the traditional approaches and methods.

I recommend the thesis for defense and after successful defense I recommend the award of Ph.D.

In Brno on 8th August 2022

doc. Ing. Martin Klimánek, Ph.D.

Digitálně podepsal doc. Ing. Martin Klimánek, Ph.D.
Datum: 2022.08.09 13:06:21 +02'00'

OPPONENT ASSESSMENT OF THE PH.D. THESIS

Author: **Mr. Elvis TANGWA**

Title of the thesis: **SPATIAL MODELS OF LANDSCAPE RESPONSES TO CLIMATE CHANGE**

Supervisor: **Assoc. prof. Vilém PECHANEC, Ph.D.**

Topicality and originality of the research topic and its importance to the field

Climate change and land cover change belong to very important and widely discussed topics because they can significantly influence the future of mankind. The thesis thus addresses a very important and up-to-date issue. The results of the thesis are important to the field of environmental protection.

Aim of the thesis

The thesis aimed to explore the suitability of various spatial modelling methods and approaches for the evaluation of landscape development. Climate change, topography, and scale were studied as key influencing factors.

Structure of the thesis

The thesis is divided into seven chapters (including introduction and discussion) and an appendix. The thesis is based on three case studies which were already published in 4 articles/papers. This fact drives the structure of the thesis.

The list of figures and tables is included. The list of abbreviations is missing.

Formal aspects

More careful processing of the thesis would be very beneficiary. There are many typographical mistakes in the work including the alignment of several paragraphs. Not appropriate chapter numbering is used in one case; namely chap. 6.3 is included 2 times. The not correct way of writing some units is used (e.g. m2 instead of m^2).

In many parts, there are not used SI units (e.g. hectare is used in chap. 6.3, p. 61 although km^2 is used as a unit in the same chapter, pages 58 – 60).

There is no legend available for Fig. 10 (p. 45), i.e. explanation of the meaning of particular shapes is missing.

In the text, there are cited two publications that are not stated in the list of references, namely Pechanec et al., 2021, and Pechanec et al., 2018.

Fig. 15 (p. 54) – absolute numbers are used to describe areas of land to be lost in particular countries. Percentage share would be more suitable as far as the countries are of different sizes.

Citation of the paper 1 (and some other papers) in chapter 6 should be complete.

Used data and methods

Used data, methods, and software are described in Chap. 5. The wide scope of the studies required the utilization of many different data sets and methods. The data sets covered adequate topics and they had different spatial resolution – according to the extent of the particular studies.

Results

The thesis has provided interesting results showing the suitability of spatial modelling for environment protection. It has contributed to the spatial modelling and understanding of some spatial problems and issues in terrains that are not easily accessible.

The thesis is concluded by a discussion of the results. The discussion provides a comprehensive comparison of the obtained results to the other studies.

Questions

1. Please, provide us the full citation of the paper 1 (chap. 6.1, page 51).
2. Please, show us the percentage share of suitable agricultural land to be lost per country and legume (Fig. 15), i.e. show us redesigned figure.
3. In chap. 6.3 (page 62 – 64) you present numeric results. Please, describe the impacts of these facts on landscape and ecosystem services, i.e. interpretation of the results.
4. You use 25° as the border value for slope (page 40). Why did you use this particular value?
5. Because of the nature of the studies, you used data at different scales/spatial resolutions. Based on your experience and literature review, please summarize recommendations and best practices. i.e. what are suitable scales/spatial resolutions for local/regional/national studies?
6. Did you involve into your thinking influence of the size of local fields on the requirement on the scale of used data sets?

Conclusion

The submitted thesis is a complex piece of work, which presents the author's contribution to the field of utilization of GIS in environment protection and management.

The author has proved his ability of scientific work including publication of the results. He has focused on the important topic and he has selected a combination of modern and suitable methods.

Based on the reasons stated above, **I recommend the Ph.D. thesis of Mr. Elvis TANGWA for the defense**. I recommend that the **author should be awarded the Ph.D. degree after clearly answering raised questions**.

Pardubice, 10. 8. 2022

Prof. Ing. Jitka Komárková, Ph.D.
Institute of System Engineering and Informatics
Faculty of Economics and Administration
University of Pardubice